Renewable Energy from the Earth

The Geothermal Spectrum

Geothermal Energy—or Earth Heat—is a clean, abundant, and renewable natural resource that is helping us meet our environmental vision. Geothermal heat pumps can be installed almost anywhere and are an ideal way to heat and cool our homes, schools and workplaces. Where Nature creates the right conditions, geothermal hot springs can provide energy for fish farms, greenhouses and municipal heating systems. And in some places, deep geologic activity creates super-hot water and steam that can be used by geothermal power plants to generate electricity for thousands of consumers. All of these uses offer renewable energy with few environmental impacts.

40˚~70˚F Average U.S. Ground Temperatures | **90˚~200˚F** "Hot Spring" Aquifer Temperatures | **200˚~700˚F** "Volcanic" Deep Resource Temperatures

Geothermal Heat Pumps

Residential and Commercial Heating and Cooling

Ground-source geothermal heat is found everywhere just a few feet below the surface of the Earth. In a widely used installation method, geothermal—or ground-source—heat pumps (GHPs) circulate water through a closed loop of plastic pipe that is inserted into vertical boreholes or laid out horizontally in relatively shallow trenches. The fluid discharges heat from a building into the ground during summer, and taps the ground's warmth during winter. GHPs are among the most efficient technologies for heating and cooling buildings. Compared to conventional systems, GHPs reduce the amount of energy used by homes and commercial buildings by 40% to 70% (including fossil fuels and power from the electric grid). They can also heat water for domestic use as a bonus. GHP systems require little maintenance, and provide reliable heating and cooling year round. GHPs use a small measure of electricity to move much greater volumes of renewable energy from the Earth to and from buildings. As a result, GHPs deliver three to four times more energy to a home or commercial structure than the unit itself consumes from the power grid.

Geothermal Direct Use

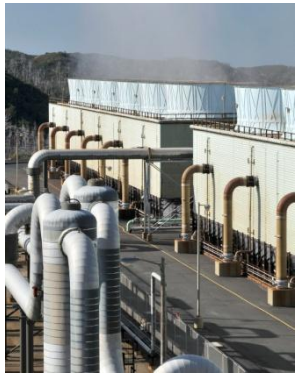
Aquaculture, Greenhouses, Resorts and Spas

In some mountainous and geologically active parts of the country, geothermal springs and aquifers yield waters that are useful directly from the Earth. From earliest times, people have used geothermal hot springs for bathing, cooking, healing and heating. Uses for naturally occurring moderate-temperature waters have greatly expanded in modern times. In the United States, primary uses now include fish farming, greenhouses, spas and hot spring resorts—and if enough resource is available—municipal district heating. Direct-Use geothermal resources are usually found at economical drilling depths. They have few if any efficiency losses, because their hot water resource is applied directly from the well to its purpose—like heating a resort pool. Equipment used for establishing direct-use geothermal projects, such as pumps and pipe, is standard and readily available. In general, the economics of direct-use geothermal projects can be very good if careful consideration is given to their product/benefit/value vs. energy benefit and distance from market.

Geothermal Power

Large-Scale Electricity Generation for the Grid

In unique locations primarily in the western United States, Nature's volcanic and other geologic forces have created deep and very hot geothermal fluid systems that are suitable for power plant development. Successful projects require great technical knowledge, large infusions of capital, and risk tolerance, considering expensive drilling of large-diameter wells up to two miles deep, and building power plants that typically cost in excess of $100 million. Geothermal fluids, whether steam or highly pressurized, super-heated water, must be efficiently contained and treated. Geothermal fluids can be highly variable, demanding complex turbine technologies for their conversion into electrical power for the grid. Residual steam is condensed in cooling towers then returned with other fluid to the deep geothermal reservoir through injection wells, helping maintain pressure and prolong resource productivity. Successful geothermal power plants have proven to be highly reliable (95+%), and provide electricity "24-7" compared to wind and solar power generation facilities.



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